

**EE 5339-003 RF Systems Engineering**  
**Fall 2018**  
**4:00-5:20pm MW, ERB130 (Lecture)**

**Instructor:**

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(817) 272-2672 (EE office)

No office is assigned by the University.

**Office Hours:**

Before 2:30pm MW outside GACB105 or by appointment. E-mail is the quickest method of contacting me on non-class days.

**Textbook:**

*Radio Systems Engineering*, Steven W. Ellingson, Cambridge University Press, 2016, ISBN 9781107068285.

**Listserv:**

Please sign up for the EE5339-L listserv to receive the latest updates, send an e-mail message to [listserv@listserv.uta.edu](mailto:listserv@listserv.uta.edu) with no subject line and the command SUBSCRIBE EE5339-L as the message body.

**Catalog Description:**

EE 5339. TOPICS IN ELECTROMAGNETICS. 3 Hours. Formal instruction in selected topics in electromagnetics. May be repeated when topic changes.

**Class Topics:**

RF terminology overview, probability/noise/fields math review

Noise: thermal/black-body/sky, quantization, noise bandwidth, noise figure/kTBF

Diversity: space, frequency, time, polarization, angle, cyclic-delay, and combining techniques

General topology: Duplexing and multiple-access, noise- vs. interference-limited systems, terrestrial and satellite systems, radar

Frequency bands: licensed vs. unlicensed bands, white-space and LAA

Modulation families: CDMA, OFDMA/SC-FDMA, 5G, IoT (BLE, WiFi, LTE, NB IoT, 5G) and impacts of modulation on RF design

Non-linearities: Modulation and PAR, clipping/CFR, compression in RF devices

Antennas: Gain (dBi), directivity, front-to-back ratio, down-tilt, polarization, aperture, basic derivation of theory for loop, microstrip, patch, array antennas, mmWave antennas, mMIMO, beam-steering, feed-line loss, efficiency, radome materials

Channel: Fading models, TDL model, absorption, scintillations, scattering, reflection and refraction, foliage, Doppler, multi-path, noise, interference, shadowing, delay spread, ISI, equalization techniques, Doppler correction, multi-path combining/RAKE, depolarization, rain/ice, sun transit

Link budget: Calculation, margin, availability

Transmitter lineup: Baseband processing, clipping, filtering, DAC, PA, VSWR, feeder losses, non-linear sources, pre-distortion techniques, filtering, intermodulation, IF- vs. direct-launch lineups, impacts of DTX on design, efficiency analysis of power amplifiers

Receiver lineup: LNA, gain control, feeder losses, down-conversion/zero-IF, ADC, baseband filtering, near-far desensitization from jammers and blockers, noise figure analysis, input intercept point, passive IM, noise sources

Measurements: EVM/rho, emissions masks, TX phase noise, ACS/ACLR, SNR, C/I, sensitivity

Regulatory: Emissions, EMC, EMI, regulatory and compliance issues, protection of GPS, RA bands

**Important Dates:**

First Class (Wednesday, 8/22), No Class (Monday, 9/3), Census Date (Friday, 9/7), Test 1 (Wednesday, 10/10), Last Drop Date (Friday, 11/2), Test 2 (Monday, 11/26), and Project Deadline (Wednesday, 11/28 @ 4pm)

(The official dates for registration, census, and dropping are available at [www.uta.edu/acadcal](http://www.uta.edu/acadcal) and supersede these dates if a conflict exists)

**Performance Assessment:**

- Grade scale: A (90-100), B (80-89), C (70-79), D (60-69), and F (0-59)
- Grade calculation: Test 1 (35%), Test 2 (35%), Project (30%)
- The instructor reserves the right to make reasonable changes in performance evaluation as needed.

**Graduate Teaching Assistants:**

All office hours are in the lab during the times at the header of this document.

Hours and GTAs will be sent on the class listserv.

**Tests:**

- Calculators, rulers, pencils, pens, books, and notes will be allowed during tests.
- Any device capable of compiling or emulating microcontrollers or microprocessors can not be used during in-class portions of the tests.
- No makeup will be provided for any test.
- Any request for re-grading must be submitted to the grader within one week of the first return date.

**Projects:**

- Projects teams will consist of 1 or 2 students. The project will consist of a report on various topics that be proposed in class.

**Attendance Policy:**

At The University of Texas at Arlington, taking attendance is not required but attendance is a critical indicator in student success. Each faculty member is free to develop his or her own methods of evaluating students' academic performance, which includes establishing course-specific policies on attendance. As the instructor of this section, [insert your attendance policy and/or expectations,

A grade of zero will be recorded for any exam, test, or project deadline that is missed. The student is responsible for obtaining notes on any material missed.

However, while UT Arlington does not require instructors to take attendance in their courses, the U.S. Department of Education requires that the University have a mechanism in place to mark when Federal Student Aid recipients "begin attendance in a course." UT Arlington instructors will report when students begin attendance in a course as part of the final grading process. Specifically, when assigning a student a grade of F, faculty report the last date a student attended their class based on evidence such as a test, participation in a class project or presentation, or an engagement online via Blackboard. This date is reported to the Department of Education for federal financial aid recipients.

**Academic Integrity:**

Students enrolled all UT Arlington courses are expected to adhere to the UT Arlington Honor Code:

I pledge, on my honor, to uphold UT Arlington's tradition of academic integrity, a tradition that values hard work and honest effort in the pursuit of academic excellence.

I promise that I will submit only work that I personally create or contribute to group collaborations, and

I will appropriately reference any work from other sources. I will follow the highest standards of integrity and uphold the spirit of the Honor Code.

UT Arlington faculty members may employ the Honor Code in their courses by having students acknowledge the honor code as part of an examination or requiring students to incorporate the honor code into any work submitted. Per UT System Regents' Rule 50101, §2.2, suspected violations of university's standards for academic integrity (including the Honor Code) will be referred to the Office of Student Conduct. Violators will be disciplined in accordance with University policy, which may result in the student's suspension or expulsion from the University. Additional information is available at <https://www.uta.edu/conduct>.

EE Department Policy requires that you sign and return a letter acknowledging the College of Engineering Ethics policy.

**Drop Policy:**

Students may drop or swap (adding and dropping a class concurrently) classes through self-service in MyMav from the beginning of the registration period through the late registration period. After the late registration period, students must see their academic advisor to drop a class or withdraw. Undeclared students must see an advisor in the University Advising Center. Drops can continue through a point two-thirds of the way through the term or session. It is the student's responsibility to officially withdraw if they do not plan to attend after registering. Students will not be automatically dropped for non-attendance. Repayment of certain types of financial aid administered through the University may be required as the result of dropping classes or withdrawing. For more information, contact the Office of Financial Aid and Scholarships (<http://www.uta.edu/aao/fao/>).

**Disability Accommodations:**

UT Arlington is on record as being committed to both the spirit and letter of all federal equal opportunity legislation, including The Americans with Disabilities Act (ADA), The Americans with Disabilities Amendments Act (ADAAA), and Section 504 of the Rehabilitation Act. All instructors at UT Arlington are required by law to provide "reasonable accommodations" to students with disabilities, so as not to discriminate on the basis of disability. Students are responsible for providing the instructor with official notification in the form of a letter certified by the Office for Students with Disabilities (OSD). Only those students who have officially documented a need for an accommodation will have their request honored. Students experiencing a range of conditions (Physical, Learning, Chronic Health, Mental Health, and Sensory) that may cause diminished academic performance or other barriers to learning may seek services and/or accommodations by contacting:

The Office for Students with Disabilities, (OSD) [www.uta.edu/disability](http://www.uta.edu/disability) or calling 817-272-3364. Information regarding diagnostic criteria and policies for obtaining disability-based academic accommodations can be found at [www.uta.edu/disability](http://www.uta.edu/disability).

Counseling and Psychological Services, (CAPS) [www.uta.edu/caps/](http://www.uta.edu/caps/) or calling 817-272-3671 is also available to all students to help increase their understanding of personal issues, address mental and behavioral health problems and make positive changes in their lives.

**Non-Discrimination Policy:**

The University of Texas at Arlington does not discriminate on the basis of race, color, national origin, religion, age, gender, sexual orientation, disabilities, genetic information, and/or veteran status in its educational programs or activities it operates. For more information, visit [www.uta.edu/eos](http://www.uta.edu/eos).

**Title IX Policy:**

The University of Texas at Arlington ("University") is committed to maintaining a learning and working environment that is free from discrimination based on sex in accordance with Title IX of the Higher Education Amendments of 1972 (Title IX), which prohibits discrimination on the basis of sex in educational programs or activities; Title VII of the Civil Rights Act of 1964 (Title VII), which prohibits sex discrimination in employment; and the Campus Sexual Violence Elimination Act (SaVE Act). Sexual misconduct is a form of sex discrimination and will not be tolerated. For information regarding Title IX, visit [www.uta.edu/titleIX](http://www.uta.edu/titleIX) or contact Ms. Michelle Willbanks, Title IX Coordinator at (817) 272-4585 or [titleix@uta.edu](mailto:titleix@uta.edu)

**Lab Safety Training:**

Students registered for this course must complete all required lab safety training prior to entering the lab and undertaking any activities. Once completed, Lab Safety Training is valid for the remainder of the same academic year (i.e., Fall through Summer II) and must be completed anew in subsequent years. There are no exceptions to this University policy. Failure to complete the required training will preclude participation in any lab activities, including those for which a grade is assigned.

**Electronic Communication:**

UT Arlington has adopted MavMail as its official means to communicate with students about important deadlines and events, as well as to transact university-related business regarding financial aid, tuition, grades, graduation, etc. All students are assigned a MavMail account and are responsible for checking the inbox regularly. There is no additional charge to students for using this account, which remains active even after graduation. Information about activating and using MavMail is available at <http://www.uta.edu/oit/cs/email/mavmail.php>.

**Campus Carry:**

Effective August 1, 2016, the Campus Carry law (Senate Bill 11) allows those licensed individuals to carry a concealed handgun in buildings on public university campuses, except in locations the University establishes as prohibited. Under the new law, openly carrying handguns is not allowed on college campuses. For more information, visit <http://www.uta.edu/news/info/campus-carry/>.

**Student Feedback Survey:**

At the end of each term, students enrolled in face-to-face and online classes categorized as “lecture,” “seminar,” or “laboratory” are directed to complete an online Student Feedback Survey (SFS). Instructions on how to access the SFS for this course will be sent directly to each student through MavMail approximately 10 days before the end of the term. Each student’s feedback via the SFS database is aggregated with that of other students enrolled in the course. Students’ anonymity will be protected to the extent that the law allows. UT Arlington’s effort to solicit, gather, tabulate, and publish student feedback is required by state law and aggregate results are posted online. Data from SFS is also used for faculty and program evaluations. For more information, visit <http://www.uta.edu/sfs>.

**Final Review Week:**

For semester-long courses, a period of five class days prior to the first day of final examinations in the long sessions shall be designated as Final Review Week. The purpose of this week is to allow students sufficient time to prepare for final examinations. During this week, there shall be no scheduled activities such as required field trips or performances; and no instructor shall assign any themes, research problems or exercises of similar scope that have a completion date during or following this week unless specified in the class syllabus. During Final Review Week, an instructor shall not give any examinations constituting 10% or more of the final grade, except makeup tests and laboratory examinations. In addition, no instructor shall give any portion of the final examination during Final Review Week. During this week, classes are held as scheduled. In addition, instructors are not required to limit content to topics that have been previously covered; they may introduce new concepts as appropriate.

**Emergency Exit Procedures:**

Should we experience an emergency event that requires us to vacate the building, students should exit the room and move toward the nearest exit. When exiting the building during an emergency, one should never take an elevator but should use the stairwells. Faculty members and instructional staff will assist students in selecting the safest route for evacuation and will make arrangements to assist individuals with disabilities.

**Student Support Services:**

UT Arlington provides a variety of resources and programs designed to help students develop academic skills, deal with personal situations, and better understand concepts and information related to their courses. Resources include [tutoring](#), [major-based learning centers](#), developmental education, [advising and mentoring](#), personal counseling, and [federally funded programs](#). For individualized referrals, students may visit the reception desk at University College (Ransom Hall),

call the Maverick Resource Hotline at 817-272-6107, send a message to [resources@uta.edu](mailto:resources@uta.edu), or view the information at <http://www.uta.edu/studentsuccess/success-programs/programs/resource-hotline.php>